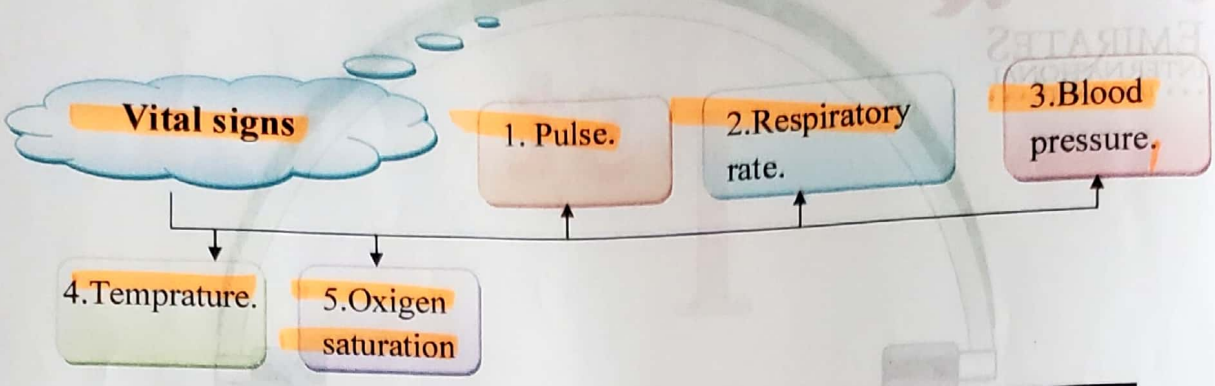
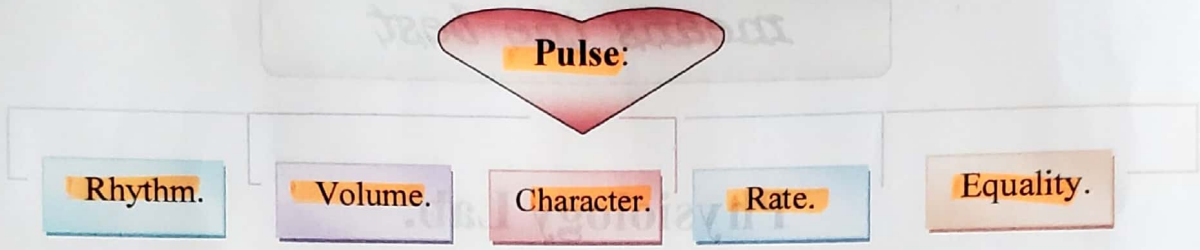
Vital Signs





مع الشرح عليها

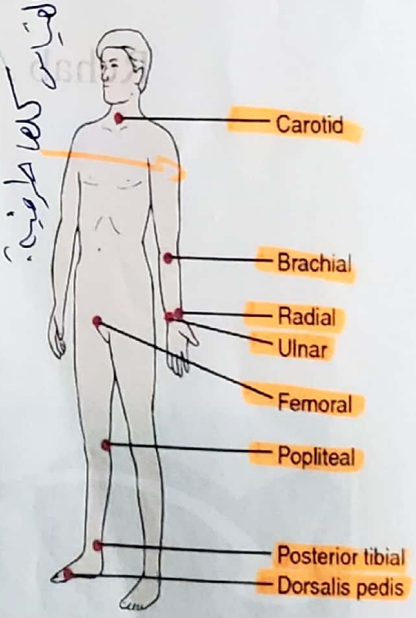
1.Pulse; → the number of beats within one minute.

Sites of pulse examination;

-Central pulses; are the pulses measured by a stethoscope directly from the heart.

مع الواقع

-Peripheral pulses; are the pulses measured by the fingers from peripheral arteries (i.e Radial, Brachial, Femoral, Carotid, Temporal, Popliteal, Dorsalis pedis, Posterior tibial).



When examining; If there is a difference between central and peripheral pulses by more than 10 beats, this indicates a serious disorder (an emergency situation) in which the patient should be immediately taken to the ICV (the Intensive Care Unit) due to the high probability of having an atrial fibrillation.

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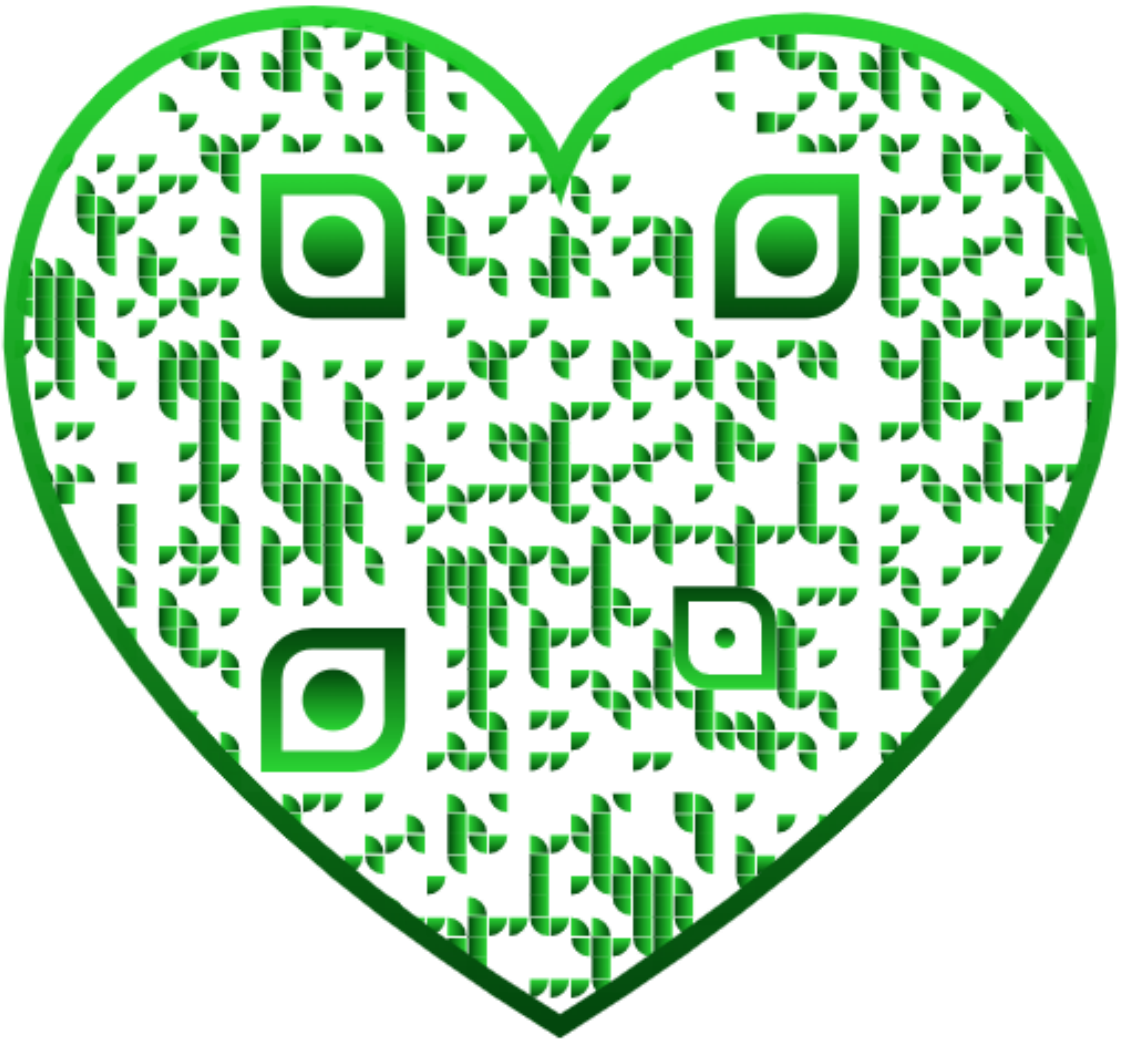

Note;

-Dorsalis pedis is located between the big and the second toes.

-Posterior tibial is located behind the medial melleolus.

Usually we use three fingers to measure peripheral pulses;

- Index is for compression.
- Middle is for Palpation.
- Ring finger is for confirmation.

Note; We do not use the thump to measure because of the possibility of confusion due to the presence of pulse in the thump, but sometimes we can use it when measuring major strong pulses specially in the carotid artery. In this case we should consider the blood supply and the effect of the vagus nerve to avoid unconsciousness (coma) of the patient.

A. Rhythm; there are three types of rhythm;

1.Regular – regular; - - - - - -

When ability to count 5 regular pulses in a sequence (continuous after each other)

$(1 \leftarrow^{0.7\ s} \rightarrow 2 \leftarrow^{0.7\ s} \rightarrow 3 \leftarrow^{0.7\ s} \rightarrow 4 \leftarrow^{0.7s} \rightarrow 5 \leftarrow^{0.7s} \rightarrow 6,\ldots)$

2.Regular – irregular; - - - - - - - - -

When no ability to count 5 regular pulses in a sequence.

$(1 \leftarrow^{0.7\ s} \rightarrow 2 \leftarrow^{0.7\ s} \rightarrow 3 \leftarrow^{1.35\ s} \rightarrow 4 \leftarrow^{0.4\ s} \rightarrow 5 \leftarrow^{0.4\ s} \rightarrow 6,\ldots)$

3.Irregular – irregular; - - - --- -- - --- --- -

When no ability to count three regular pulses after each other.

$(1 \leftarrow^{0.7s} \rightarrow 2 \leftarrow^{0.4s} \rightarrow 3 \leftarrow^{0.7s} \rightarrow 4 \leftarrow^{1.4s} \rightarrow 5 \leftarrow^{0.5s} \rightarrow 6,\ldots) \rightarrow$ Atrial fibrillation.

B. Rate (beat \ minute);

- Method; by counting the pulse for 15 seconds then multiply the result by 4.
- Normal range; 60→100 b\m.
- In case of irregular pulse count the pulse for 1 minute.
- Bradycardia→less than 60 b\m.
- Tachicardia→more than 100 b\m.

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- Atrial fibrillation→more than 150 b\m.

Normal conditions including brady\tachicardia	
Tachicardia	Bradycardia
Pregnancy (due to increase metabolism)	sleep
Emotional state (ex; fear, stress, anxiety, excitement,…)	Emotional state (ex; sadness, depression, frustration,…)
Exercise .	

C. Volume;

- Definition; pulse volume is the strength of the pulse, which indicates the amount of blood flowing (blood volume).

When detecting;

- Strong pulse → ↑ high volume pulse → easy to be detected.
- Week pulse → ↓ low volume pulse → hard to be detected.

Normal range; 25→40 mm Hg.

Volume = systolic pressure – diastolic pressure.

Notes;

1. High volume pulse is present normally in case of pregnancy.
2. There is a normal difference in volume between the right and left sides(10 mm Hg) the left arm is lesser than the right, if the difference is more than 10 mm Hg, it indicates a disorder.

D. Equality;

Also known as 'Bilateral presence'.

- Usually, 2 types of pulse appear ;

1. Symmetric pulse;

Pulses on both sides of human body should be the same in rate, rhythm Ns more importantly volume.

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2. Asymmetric pulse;

Pulses of both sides of the body differ in rhythm, rate and volume.

Note; we compare the pulse of the 2 hands **or** the 2 legs, **not** of a one hand with a one leg.

E. characters (water hammer pulse);

- Normally, no special characters appear. However, pregnant women have a special character named (*water hammer pulse*), it occurs here due to the increase of plasma by 40-50% during pregnancy which might cause aortic regurgitation.
- This condition may also appear pathologically among patients with aortic regurgitation or anemia.

-Water hammer pulse; an abnormal pulse occurs as a result of blood flowing backwards in arteries to the left ventricle because of an aortic insufficiency (regurgitation) in which the aortic valve allows blood to get backwards.

Method;

1. Put your lateral 4 fingers on the ant-middle surface of patient's forearm, and put your thumb on the post-middle surface .
2. Put your other hand just proximal to wrist .
3. Wait for 5 seconds, then lift (raise) the patient's forearm upwards gently.
4. If you feel a pulse in the patient's forearm , this indicates that the blood in arteries has been regurgitated backwards (water hammer pulse) , and it is a serious condition leading to many consequences.

2.respiratory rate (R.R); → the number of breath cycles per one minute.

Note; breath cycle is one inspiration + one expiration which is considered as one total breath.

Normal range; (12→ 20 c.\ min.)

Bradypnea→ less than 12 c.\ min. (Hypoventilation).

Tachypnea→more than 20 c.\min. (Hyperventilation).

Types of respiration;

1.Abdominothoracic (Usually in males) →the muscles of the abdomen are stronger than muscles of the thorax, thus the breath cycle appears through the movement of the ant-abdominal muscles.

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2.Thoracoabdominal (Usually in females) → the muscles of the thorax are stronger than the muscles of abdomen, thus the breath cycle appears through the movement of the thoracic muscles.

Notes;

- The Thoracoabdominal type is in females since the ant-abdominal wall muscles are weak and tensile so they have the ability to expand easily during pregnancy.
- Children, under 7 years old, exhibit an abdominal breathing cycle.

Method;

1.Distract the patient's attention by acting as if you are counting heart rate (Radial pulsation), so the patient does not get stressed (his breath stays normal; neither slower nor faster) .

2.Count how many times the abdomen or the chest raises (according to the type) for a whole minute.

Character;

- Normal (periodic apnea within ↓5-year-children) →((**physiological**));

A periodic apnea, which is on apnea for 15 seconds with no change in heart rate, may occur in children, whose age is under 5 years old. It is a physiological case in children occurs mainly due to the immaturity of the respiratory system in fetuses (newborns).

- Abnormal (cheyne-stoke within adult people) →((**pathological**));

Cheyne-stroke is abnormal pattern of breathing characterized by tachypnea and then gradual ↓decreasing of breath, and then tachypnea again, and this cycle (rhythm) continues.

Note; the cause of cheyne-stoke is an organ failure, such as heart failure, lung failure or stroke.

Note;

Causes of bradypnea;

1.Opioids;

opioids are substances acting on opioids receptors for pain relief.

- Examples of legal opioids (drugs) →Morphine and Codeine.
- Example of illegal drugs→Heroine.

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2.Hypercapnia (hypercarbia):

Happens due to abnormal increase of CO_2 level in blood.

Causes of tachypnea;

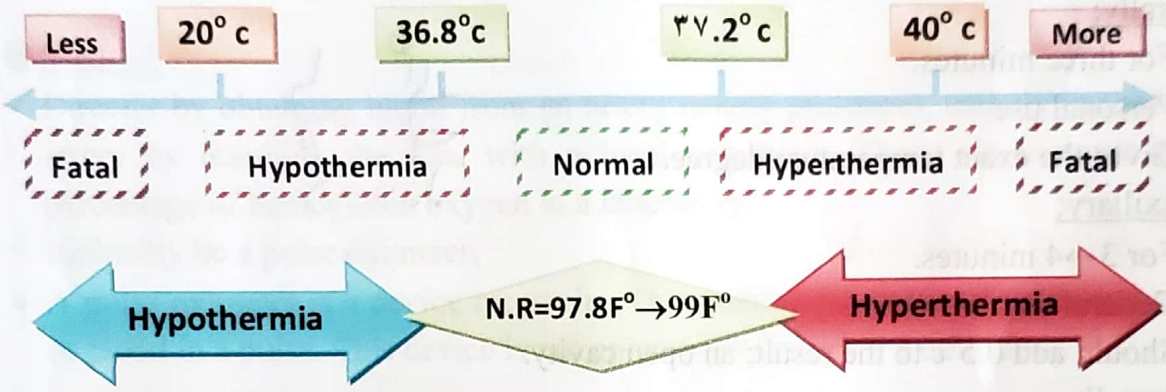
1.Asthma.

2.Pulmonary disease (Tachypnea is the first sign of lung inflammation).

3.Pneumnia (pulmonary inflammation) →happens as a result of smoking.

3.Body temperature;

نسيب اسأل وأجيب بعد المحاضرة



Temperature Testing sites;

A.Oral ;

Sublingual and lateral, so it is away from the nose and the air of breath, for personal use only(to avoid infections), and it gives the exact body temperature.

B.Axillary;

In the armpit, which is an open cavity, so 0,5°c is added to the result in order to get the accurate temperature (+0,5°c). It is commonly used because it exhibits no risk of crossing infections.

C.Tympanic;

In the ear canal (It is usually used in air ports).

D.Rectal;

Through the anus in the rectum. It is used for newborns. Since rectum is a highly vascular closed cavity, 0,5°c is usually subtracted from the result (-0,5°c).

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E. Skin;

By special thermometer, like a paper, put on the forehead.

Types of thermometers;

A. Electronic thermometer;

-It has probe (projection) which is put on one of the temperature sites (mostly; ear or axilla).

B. Glass thermometers containing mercury;

-It raises when exposed to temperature indicating it in degree Celsius, and it is usually used in 3 sites;

1.orally;

- For three minutes.
- Personal use.
- Gives the exact temperature degree.

2.Axillary;

- For 3→4 minutes.
- General use.
- Should add 0.5°c to the result; an open cavity.

3.Rectally;

- For 2→3 minutes.
- Neonates.
- Should subtract 0.5°c of the result; a highly vascular closed cavity.

Note; before using glass thermometer, make sure that there is no leaked mercury. In order to get the right result, shake the thermometer gently in a half-circular manner before each use.

Causes of hyperthermia;

1.Phisiological causes; exercise, emotion(rage), hot weather,…etc.

2.pathlogical causes; Infections and fever (pyrexia).

Causes of hypothermia;

1. Physiological causes; sleep, and cold weather.

2.Pthological causes; coma, starvation, and hypothyroidism.

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4.Oxygen saturation; → is the percentage of oxygen saturated hemoglobin to the total hemoglobin (saturated & unsaturated).

Normal range; (95→100 percent) ;

More than 95%→ Normal.

Less than 95%→Hypoxia.

Methods of O_2 saturation measurement;

1.Blood Gas test (ABG):→ (Arterial Blood Gas) is a blood test measures peripheral O_2, CO_2, PH & HCO_3.

Method;

- ✓ Directly by obtaining blood from an artery (artery puncture), usually the radial artery by numbing the area with a local anesthetic. Then, we measure the percentage of hemoglobin oxygen in a laboratory.
- ✓ Indirectly be a pulse oximeter;
- A pulse oximeter is a device measuring O_2 saturation by measuring the volume of blood in a pulse. This device is put on an adult finger, or a child foot.

Special cases requiring the use of pulse oximeter;

1.Asthma.

2.Pneumonia.

3.C.O.P.D (chronic obstructive pulmonary disease); in the case of C.O.P.D we do not give the patient 100% of O_2 because he will die, so we give him less than 100%.

Notes;

- Do not confuse oxygen saturation with oxygen tension;

Oxygen tension (partial pressure of oxygen); is the pressure exerted by O_2 in a mixture of gases. This pressure is thought to be in blood (its increase may increase blood pressure).

Normal range;

-In arteries→ (75-100 mm Hg).

-In veins→ (30-40 mm Hg).

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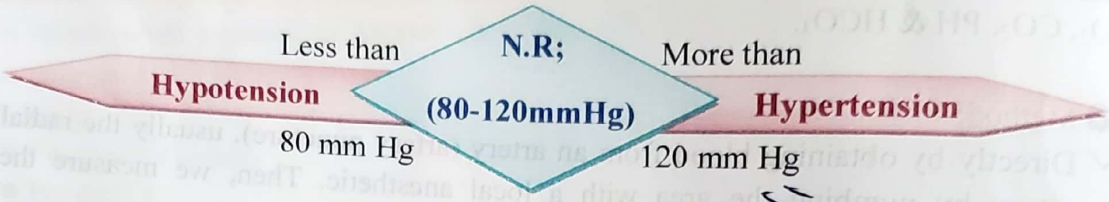
Pain;

Sometimes, pain is considered as a vital sign in some books, and it has a score; (0→10). Healthy people do not feel the pain (unless abnormally); therefore, they have a very low score (0). On the other hand, the range (0) is also scored in case of death, thus, pain is not generally considered as a principal vital sign.

5.Blood pressure; →is the force exerted on the walls of arteries by blood.



❖ Types of blood pressure;

A. Systolic blood pressure (SBP);

SBP is the pressure exerted on the arterial walls during cardiac contraction (best measured by palpatory method (120 mmHg) see page no17.

B. Diastolic blood pressure (DBP);

DBP is the resting pressure on arterial walls during cardiac relaxation (best measured by auscultatory method (80 mmHg) see page no18.

Note;

-Pulse pressure is the difference between systolic and diastolic (BP_s); 120-80 = 40 mmHg.

Factors determining and maintaining arterial BP (BP = CO×PR);

A. Cardiac output;

It is directly proportional to BP.

B. Peripheral resistance;

It is directly proportional to BP.

C. Elasticity (compliance) of the aorta and other arteries as BP;

It is directly proportional to stiffness, but inversely proportional to distensibility.

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(Elasticity↓ Vs Age↑)→ BP↑;

Usually, arteriosclerosis begins to occur normally in the intrauterine period, then it continues throughout the life. Thus, arteries get more stiff and accordingly, blood pressure increases. When getting aged, the risk of having hypertension increases due to the over arteriosclerosis. Contrarily, young people have more elastic arteries which keep their BP normal, but some factors such as obesity, smoking and unbalanced style of life increase the rate of arteriosclerosis abnormally causing BP to increase earlier.

Factors that affect BP;

1.Age;

BP increases↑ with age as the arterial walls harden;

(↑Age→↑Arteriosclerosis "stiffness"→↑BP).

-Newborns (40→50/70→80 mmHg).

-Adults (80→120 mmHg).

-Elderly people (80→150 mmHg).

2.Gender;

BP is slightly higher↑ in males.

3.Race;

Often BP is high↑ in western countries.

4.Temprature;

BP increases↑ with temperature.

5.Emotional stress;

BP increases↑ with emotional stress.

6.Emotional depression;

BP decreases↓ with emotional depression.

7.sleeping;

While sleeping, BP is slightly decreased↓.

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8.smoking and Qat chewing;

They increase↑ BP.

9.Exercising;

BP is markedly increased↑ while exercising.

❖ Notice the difference between training and exercising;

- ✓ Training is mostly for athlete people while exercising is for average people.
- ✓ Training of athletes does not affect their vital signs because their bodies have been adapted.
- ✓ Exercising of average people obviously affects their vital signs because they are not used to do it, thus it is called exercise.

10.Caffeinated beverages;

Drinks containing Caffeine (legal stimulants i.e. Coffee, tea,...etc) usually increase↑ BP.

11.Atherosclerosis;

Resulting from obesity, smoking, and unbalanced life style (sedentary), Atherosclerosis increases arterial wall hardening. As a result, BP is increased↑.

Extra information; other minor factors affecting BP;

A. posture;

When someone suddenly stands up, his BP is decreased↓ but still remains within normal so it is called (postural hypertension).

B. Postprandial hypertension;

After eating a meal, the blood goes to the GIT system causing BP decrease↓.

C. Acceleration;

-If a person goes up in an elevator, his BP becomes decreased↓ (hypotension) because of the movement against the gravity.

-If a person goes down in an elevator, his BP becomes increased↓ (hypertension) because of the movement with the gravity.

Note;

- The acceleration mainly affects systole, but both systole and diastole may be affected.

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- In this case, the increase and decrease of BP depends on;
  - The speed of the elevator.
  - The distance that the elevator crosses.

- Blood pressure regulation's types;

A. Local regulation (depending on end metabolites);

1. CO_2;

Mild hypercapnia (moderate CO_2 increase) increases BP to decrease CO_2 level.

Note; Oxygen tension→Because of low levels of oxygen (hypoxia), the BP is usually increased↑;

($\downarrow O_2 \rightarrow \uparrow CO_2 \rightarrow \uparrow BP$).

2. Lactic acid;

Its accumulation increases↑ BP.

- Local regulation also depends on other molecules;
  - ✓ K^+ accumulation outside cells causes vasodilatation of arterioles, decreasing peripheral resistance. Thus, BP is decreased↓.
  - ✓ Nitric oxide (NO); is a substance present normally in body cells and can be obtained from plants. It vasodilates arterioles, decreasing↓ BP because of the decreased resistance. That is why, patients with hypertension are advised to eat vegetables.

B. Systemic regulation;

1. short-term regulation (fast, within a minute or four seconds (mostly nervous; (via→A.N.S));

1) Baroreceptors;

These are stretch receptors in the walls of large blood vessels, especially the carotid sinus and aortic arch. They are sensitive to mechanical stimulation. Thus, when BP is increased stretching these receptors more than normal, they send messages to the cardiac inhibitory center and VDC (vasodilator center) via the sinus and aortic nerves resulting in a decrease of blood pressure and vice versa.

2) Chemoreceptors;

These are receptors responding to chemical substances, located in sinus and aortic bodies. For instance, if serotonin is injected to a person, they can be affected sending messages to the cardiac inhibitory center and VDC via buffer nerves causing hypotension.

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Note;

Cardiovascular center (vasomotor center);

Def: it is a center of the brain concerned with regulating blood pressure, perfusion, …etc, mainly through vasoconstriction and vasodilatation.

	VCC (vasoconstrictor center)	VDC (vasodilator center)
Stimulated by	Sympathetic N.S	Parasympathetic N.S
Leading to	Increase B.P	Decrease B.P

2.Long term regulation (slow, within weeks, months or years (mostly hormonal);

1) Catecholamines;

Epinephrine, Norepinephrine and Dopamine are (fight or flight) hormones released by adrenal medulla of suprarenal (adrenal) gland. When sympathetic nervous system is stimulated, BP is increased.

2) Corticosteroid;

Cortisol, Aldosterone, and Androgen are hormones released by the adrenal cortex and they usually increase BP.

- Note; Aldosterone stimulates reabsorption of Na^+ and water from kidney tubules, causing the blood volume to increase (hypervolumia). Thus, BP is increased.

3) Anti-diuretic hormone (ADH) vasopressin;

ADH is a hormone released by pituitary gland stimulating reabsorption of water from kidney tubules, especially the connecting tubules (Henle Loop). As a result, blood volume is increased and consequently the BP is increased.

C. Auto regulation;

- This refers to the mechanism by which angiotensin is released, including its effect. There are special interregnal baroreceptors which are juxtaglomerular cells in the walls of afferent renal arterioles. In case of hypotension (renal ischemia), these cells produce renin, which converts angiotensinogen into a decapeptide and angiotensin(1), which is a weak vasoconstrictor. That is why, it

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is converted by angiotensin-converting enzyme (ACE) into the strong vasodilator; angiotensin(2).

Note;

- Actions of Angiotensin;

✓ General vasoconstriction, which increases BP.

✓ Increasing Aldosterone, so Na^+ and water are reabsorbed. As a result, BP is increased. _Look for other actions in Magdi Sabri handout page (108).

+ Blood pressure measurement;

- Types of BP measuring devices and their accuracy;

A. Electronic (digital);

-The least accurate.

B. Aneroid (هوائي);

-More accurate than electronic.

C. Sphygmomanometer (mercury device);

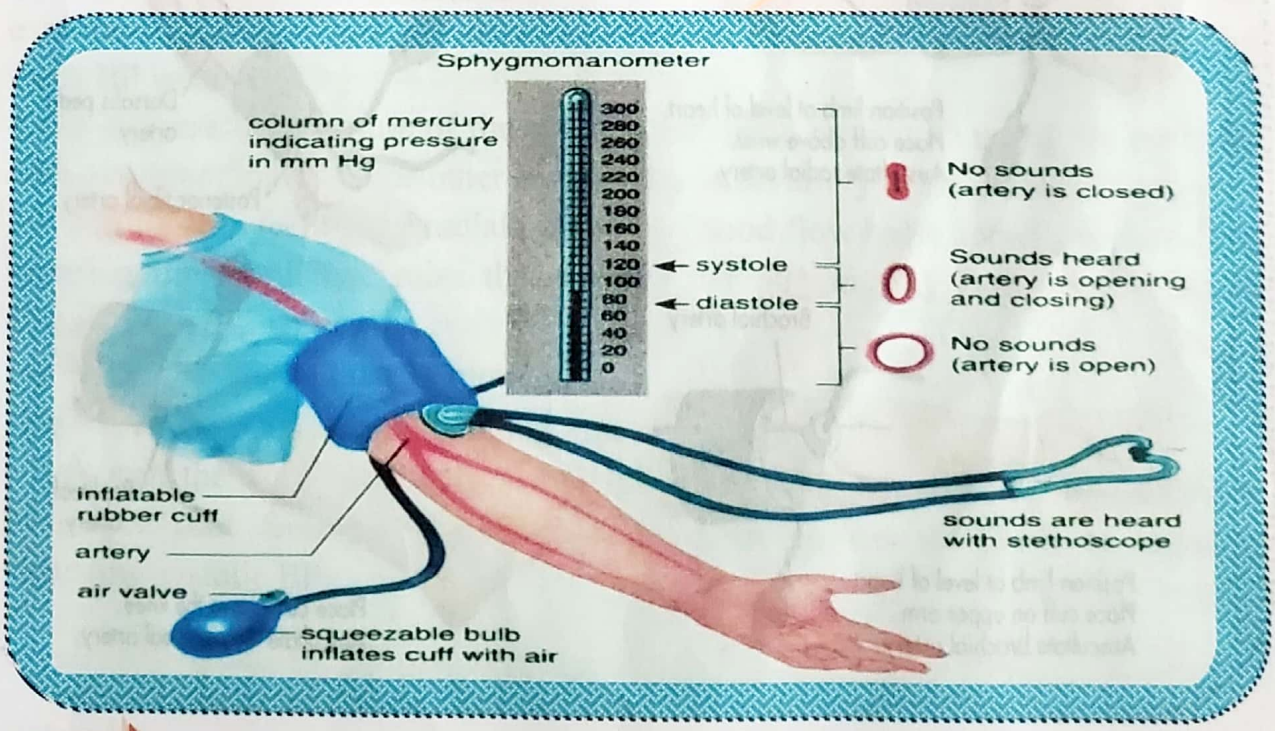
i. Components;

✓ Calibrated glass tube containing mercury.

✓ Cuff (rubber bag).

✓ Stethoscope; ear tips, ear tubes, diaphragm.

✓ Air bulb (the pump).



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روحاني كوول

ii. Approach:

- Cuff:

It is usually wrapped around the arm under the following conditions;

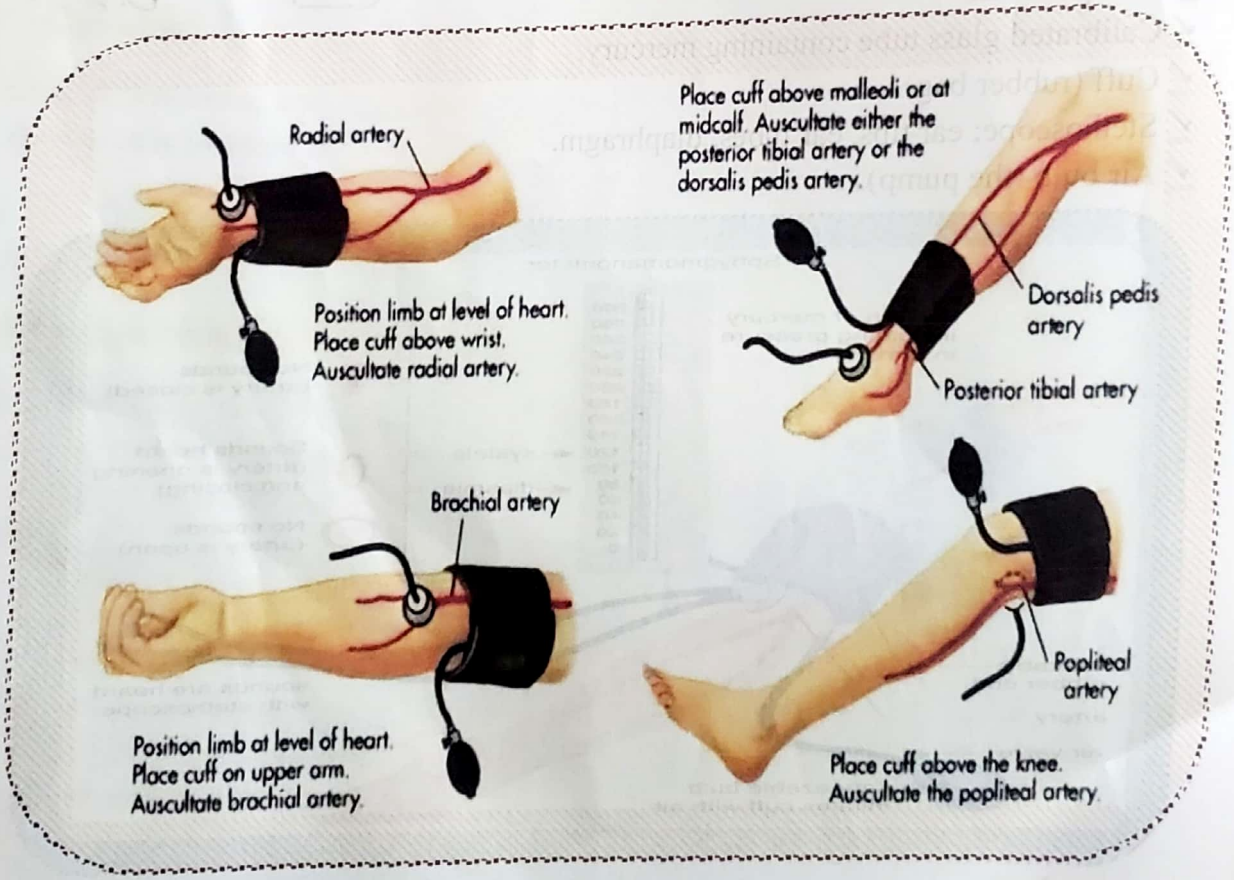
- It should be 2 fingers (1inch) above the cubital fossa.
- The 2 tubes, connecting to it, should be slightly medial; since the brachial artery is slightly medial so it would be between the two tubes.
- The cuff should not be tight so that the tip of the little finger can easily be placed under the cuff.

- Special cases;

1. If the patient is a little child or a very thin person, it is preferred to use a smaller cuff. If not possible, we can put the cuff on the thigh (Popliteal artery).
2. If the patient is obese, it is preferred to use a larger cuff. If not possible, we can put the cuff on the forearm (radial artery).

- Generally, the cuff must be folded at least (1 & half) folds.

- **Note;** The brachial artery is mostly used for measuring because it is at the same level of the heart (nearly the forth intercostal space) to eliminate the effect of gravity.


Radial artery
Position limb at level of heart.
Place cuff above wrist.
Auscultate radial artery.
Place cuff above malleoli or at midcalf. Auscultate either the posterior tibial artery or the dorsalis pedis artery.
Dorsalis pedis artery
Posterior tibial artery
Brachial artery
Position limb at level of heart.
Place cuff on upper arm.
Auscultate brachial artery.
Popliteal artery
Place cuff above the knee.
Auscultate the popliteal artery.

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Measuring methods;

A.palpatory method;

It is used to accurately measure systolic blood pressure, so we can avoid the auscultatory gab and accurately measure the diastolic BP in the auscultatory method.

Steps to apply;

1.We put the arm of the patient at the same level of the instrument. Usually, at the level of the fourth intercostal space.

2.Confirm that the switch at the base of mercury tank is opened.

The switch is opened (away from the mercury bar)

The switch is closed (towards the mercury bar)

3.We close the valve (not tightly!), So we can easily open it gradually without extreme decrease of mercury column which usually causes a less value than the exact BP value.

4.We increase the pressure of the cuff (by pumping air into it) using the air bulb, with our three fingers of the other hand on the radial artery of the patient.

5.When we stop feeling the radial pulsations (blood flow has stopped), we continue pumping the air till we raise the mercury bar **30*** mmHg more then we stop pumping.

***Do not** raise it more than **30** mmHg.

***Do not** keep this pressure for a long time→ ischemia.

6.We open the valve gradually (1mmHg\second),with our eyes on the mercury. When we start feeling the pulsations, we read against the level of mercury indicating systolic BP.

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B. Auscultatory method;

It is used to accurately measure diastolic BP.

Steps to apply;

1. Open the switch.
2. We close the valve not tightly.
3. We put the stethoscope's ear tips anteromedially to properly inter the external ear canal, which is directed posterolaterally. Then, we put the diaphragm on the cubital fossa medially (on the brachial artery).
(Make sure that the stethoscope's diaphragm is fixed so we hear sounds magnified through the diaphragm itself, if the diaphragm is not fixed, the sounds will not be magnified and we will hear them by outside the diaphragm).
4. We increase the pressure by pumping the air bulb above the previously detected systolic BP by **30** mmHg to avoid auscultatory gab.
5. We open the valve gradually (1mmHg\second), and the first heard sound is approximately the systolic BP (known as Systolic Korotkoff), and the last heard sound; first disappearance of sound is the diastolic BP (known as Diastolic Korotkoff).

Notes;

- The lower limb BP is more than the upper limb BP by 20mmHg due to gravity.

- Q_1; When measuring by the auscultatory method, we might face some cases with non-disappearing systole sound. Explain how to detect the diastolic BP.

- In this case, we record the value where the sound becomes clearly light (called phase 4), this mainly occurs within pregnant women and patients with aortic regurgitation.

- **Auscultatory gab** is a period of time before systolic BP, when no sounds (*Korotkoff*) can be heard by a stethoscope. It is important to avoid not to underestimate BP.

- Q_2; How to avoid auscultatory gab?

- By accurately measuring SBP(via palpatory method), and then adding **30** mmHg over SBP value.

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أبو علي الروحاني

- Q_3; Is there palpatory gab? Explain.

- Yes, but it is easily avoided by waiting for arterial pulsation in the palpatory method. That is why, it is not even mentioned.

- **Korotkoff** is the blood flow sound, heard by stethoscope, in the artery. It is used to measure BP (usually brachial artery) via sphygmomanometer. It is called by this name due to the fact that the first scientist who detected these sounds is a Russian called Korotkoff.

- **White coat hypertension (sometimes is called phobia or syndrome);**

- It is a condition in which some people fear doctors wearing laboratory coat; thus a fight or flight response is immediately initiated, increasing the sympathetic activity, and their blood pressure is consequently elevated.
- In such a case, doctors should have at least 5 minutes with the patients to reduce stress.

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